

Unit



Structure of Human Eye

INTRODUCTION

How many of your family members use spectacles?

Let us study how the human eye uses light and enables us to see objects.

Eyes are the most valuable organ of the human body, which process the images of objects in the vicinity. The eyes interpret size, shape, colour and distance of the objects and give a 3D picture of the objects visible.

The eyes are seated in a hollow cone shaped cavity (socket) of the human skull named orbit. The movements of the eye are regulated by six muscles. Fatty tissues in the orbit surrounding, which protect the eyeball, give it flexibility to function. The adnexal structures, like eyebrows, eyelashes, eyelids, protect eyes from foreign elements and injuries.

The liquids maintaining the shape of the eyeballs are called aqueous humour and vitreous humour.

The eyeball acts like a camera; the image of the objects received by the eyes are conducted to the brain. The visibility by one eye is known as monocular vision, and that by both eyes is binocular vision.

Did you know?

Our eyes are sophisticated cameras; they take many pictures in seconds and the brain processes them as messages. Through our eyes, we see the colourful world around us.

SESSION 1: ANATOMY OF HUMAN EYE

In this session, you will learn about the parts of human eye (Fig. 1.1) and their functional connections with the human body. The human eye is one of the important sensory organs of the human body. It is very sensitive and exposed to various diseases, thus protection and prevention is necessary to keep the eye safe and healthy.

Three layers of human eye

The eyeball has three coats as given below.

External fibrous coat

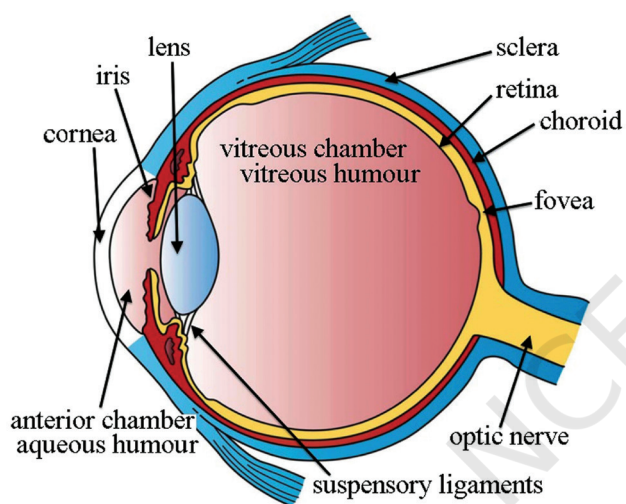


Fig. 1.1: Structure of Eye

The anterior, transparent, one-sixth part of the eyeball is called cornea. This refracts the rays of light into the eye. Cornea further extends with a membranous structure called conjunctiva. The connecting area of cornea and conjunctiva is limbus. External fibrous coat is formed of cornea and sclera.

Middle vascular coat

This coat is formed by the iris, ciliary body and choroid (anterior to posterior). This coat is vascular and pigmented, underlying the sclera.

Internal nervous coat

Internal nervous coat is formed of retina. The retina receives an inverted image of the objects seen. These images are conducted to the brain through a nerve called the optic nerve, which is connected at the posterior end of the eyeball.

Parts of human eye

(a) Anterior chamber: It is the one-third part of the eyeball which is bound by the cornea anteriorly, and the lens posteriorly. It contains the iris and a fluid called the aqueous humour.



(b) Posterior chamber: It forms the rest of the two-thirds of the eyeball, bound by the intraocular lens anteriorly and optic nerve head and retina posteriorly. It contains a gelly-like fluid called vitreous humour.

(c) Pupil: It is an aperture of variable size in the centre of iris, which regulates the amount of light entering the eyeball.

(d) Iris: It is the coloured membrane behind the cornea and in point of lens with an aperture of variable size called pupil. It has a circular and long muscle fibre. Iris is attached to the ciliary body.

(e) Lens: It is a transparent, biconvex structure situated between the iris and vitreous humour. Its function is to focus the luminous rays; these rays form a perfect image on the retina. With age, the central portion of the lens compresses by the surrounding fibres and results in opacity, which is called cataract.

Blind spot

The beginning of the optic nerve in the retina is called the optic nerve head or optic disc. Since there are no photoreceptors (cones and rods) in the optic nerve head, this area of the retina cannot respond to light stimulation. As a result, it is known as the 'blind spot', and everybody has one in each eye.

(f) Vitreous humour: This is a gel-like substance which maintains the shape of the eyeball. It is also a refractive media.

(g) Retina: It is a transparent layer forming the inner coat of the eye, it supports the choroid layer. The rays of light, on entering the eyeball, converge and form an image on the fovea—the posterior part of the eye on retina.

(h) Sclera: It is the outermost coat of the eyeball. It maintains strength and structure of the eyeball. It is also known as the white of the eye.



(i) Cornea: It is the clear, transparent, anterior portion of the external coat of the eyeball. The rays of light enter this layer. Cornea accounts for two-thirds of the total optical power of the eye.

Practical Exercise

Visit an eye care unit or clinic with your friends and teacher to observe various charts displaying the anatomy of eye.

Check Your Progress

A. Fill in the blanks

1. The _____ is the transparent front part of the eye.
2. The _____ is a gel-like substance that helps to keep the eyeball in its proper shape.
3. The _____ is also known as the white of the eye.

B. Label the parts of the eye in Figure 1.2 and also list them in the Table given below.

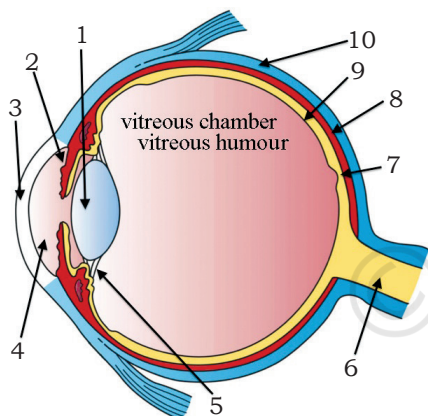


Fig.1.2: Parts of Human Eye

S.No.		S.No.	
1.		6.	
2.		7.	
3.		8.	
4.		9.	
5.		10.	

SESSION 2: FIELD OF VISION AND DYNAMIC RANGE OF HUMAN EYE

In this session, you will learn about the field of vision and the dynamic range of the human eye. The eyeball acts as a camera and the message of image formation is received and directed to the brain.

Field of vision

The field of vision is the area that is seen all around. The field of view of a human eye is 95° on the left or right of



the eye, 75° downwards, 60° towards the nose, and 60° upwards (Fig.1.3). It is in this space that an object can be seen while the eye fixes upon one point.

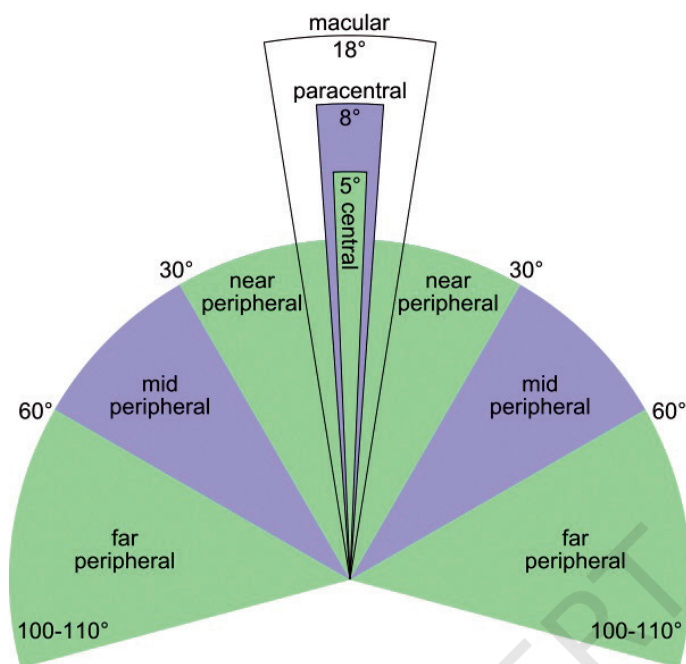


Fig. 1.3: Field of vision for human eye

Monocular vision

Monocular vision is the vision when each eye is used separately to see an object.

Binocular vision

Binocular vision is the vision when both eyes are used together to see an object. It gives perception of size, shape and depth of the object seen. As a result, the object seen by either eye is interpreted as a single image. Thus binocular vision is important, and required for drivers, pilots and such coordinated operations like catching a ball, etc.

Practical Exercise

Visit a nearby eye unit or clinic with your friends and teacher. Observe how the ophthalmologist studies the field of vision and extraocular muscles, balancing the eye system of a patient.

Did you know?

Why do we have two eyes for vision and not just one?

There are several advantages of having two eyes instead of one. It gives a wider field of view. A human being has a horizontal field of view of about 1500 with one eye, and of about 1800 with both eyes. The ability to detect faint objects is, of course, enhanced with two detectors instead of one.

Some animals, usually prey animals, have both their eyes positioned on opposite sides of their heads to give the widest possible field of view. But our eyes are positioned on the front of our heads, and it thus reduces our field of view in favour of what is called stereopsis. Shut one eye and the world looks flat-two-dimensional. Keep both eyes open and the world takes on the third dimension of depth. Because our eyes are separated by a few centimetres, each eye sees a slightly different image. Our brain combines the two images into one, using the extra information to tell us how close or far away things are.



Check Your Progress

A. Fill in the blanks

1. The _____ is the extent of the observable world.
2. _____ vision is one in which each eye is used separately.

B. Short answer questions

1. Describe the field of view of the human eye.
2. Why is Binocular vision required for coordinated operations?

SESSION 3: MOVEMENTS OF HUMAN EYE

In this session, you will learn about the types of eye movement.

Types of eye movement

The movement of eyes is under voluntary control of the eyes. The types of movement include voluntary (both vertical and horizontal), tracking (both voluntary and involuntary) and convergence. The movements of the eye must conjugate in order to prevent double vision. The retina is a photo-sensitive layer that forms about 65% of inner surface of the eyeball. At the posterior end of the retina is a small elevation called the fovea or fovea centralis (Fig. 1.4). It has the sharpest vision and colour perception.

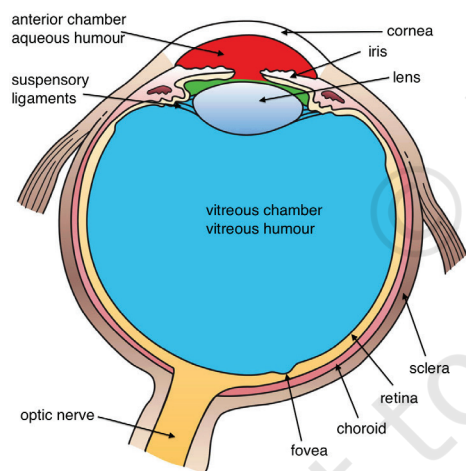


Fig. 1.4: Diagram showing Fovea

Muscles of the eye

The movement of eyeball is controlled by six muscles. Each eye moves in all the directions. The eyes also have a rotational movement. Horizontal eye movements are controlled by the medial and lateral rectus muscles, while superior rectus and inferior rectus muscles perform superior and inferior movement of the eyes. A machine is used by ophthalmologists to record muscle balances and movements of eyes it is called synaptophore (see Fig. 1.5).



Extra ocular cranial nerves and nuclei

There are three cranial nerves innervating eye muscles. The oculomotor nerve, (CNIII), innervates all of the extra ocular muscles. It also innervates the elevator of the upper lid. In addition, cranial nerves no. II, IV, V and VII also have play a role in other functions of the eyes, such as movement of upper lid, tear secretion, etc.



Fig. 1.5: Synaptophore machine

Tracking or smooth pursuit eye movements

We are able to move our eyes smoothly when tracking a moving object. This is an involuntary fixation on objects that are moving in relation to the head. The eyes have the tendency to track moving objects.

Practical Exercise

Visit a nearby eye unit or clinic with your friends and teacher. Observe the operation of the synaptophore.

Check Your Progress

A. Fill in the blanks

1. In the middle of the retina, there is a small elevation which is called the _____.
2. The movements of the eye must conjugate in order to prevent _____.
3. Horizontal eye movements are controlled by medial and lateral _____ muscles.

B. Short answer questions (30-40 words)

1. What is fovea centralis?
2. Name the four movements of eye.
3. Name the muscles of the human eye.
4. Which cranial nerves take part in the functioning of eyes?

